Case studies for intelligent pigging of 'unpiggable' offshore pipelines

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Intero Integrity Services

• Formerly A.Hak Industrial Services
  • A.Hak founded after WW-II in post-war rebuilding
  • A.Hak Industrial Services founded in 1985
  • Since end 2017 owned by First Reserve
  • 2019: 350+ people around the world

• European leader Industrial Services

• Global provider of advanced Inspection & Integrity Services
Intero’s Inspection Services

• **Fields of activity**
  • Global provider of advanced **inspection services**
  • Specialist for **challenging pipelines**
  • Major player in **furnace inspection** industry
  • Pioneer in field of on-line **robotic tank inspection**
  • Proven **PIMS system** & services provider

• **Technology center**
  • Research & development
  • Tool manufacturing, testing & validation
  • Testing and solution engineering
  • Personnel training
  • Client demonstration and classes
Intero’s Pipeline Inspection Services

- Pipeline inspection
  - Specializes in “unpiggable” pipelines
  - In-house ability multidisciplinary operations
  - Operational excellence, high standards
  - Provision of supporting equipment
  - Integrated in-house engineering
  - Experienced research & development
  - In-house training, demonstrations etc.
  - AIMS from basic GIS to full PIMS system
  - Data management and risk assessments

Integrated package from pipeline cleaning & inspection to full pipeline integrity management
Intero’s Piglet® family

- Main characteristics
  - In-house developed, compact & scalable, aimed for challenging applications
  - Bidirectional, low pressure, small radius bend capability, dual diameter applications
  - Wall thickness inspection, geometry inspection and XYZ mapping in a single run
  - Allows both tethered and freeswimming applications, simultaneously
  - Ultrasonic principle allows inspection of CS, SS, Duplex, (HD)PE, etc.
Intero’s Piglet® family

- **Main characteristics**
  - Rotating mirror allows compact configuration, wide variety of integration
  - Centralized measuring head makes accurate geometry measurements possible
  - Sends and stores full A-scan, allowing detailed data analysis and defect assessment
  - Focusing mirror allows small ultrasonic footprint,
  - Infinite measuring grid realizes ultra high resolution
Challenging offshore cases

- 18” offshore gas production pipeline
  - Bidirectional inspection against network pressure

- 8” pipeline from a subsea manifold to the platform
  - Turn key project with pre-loaded launcher approach

- ‘standard’ 4” pipeline with heavy wall thickness bends
  - Engineering to adapt to unforeseen circumstances

- 12” riser in a dry caisson - gravity-fed
  - Winch-operated internal bulkhead inspection

- 8” – 12” dual diameter interfield pipeline
  - Coping with challenges - worldwide
18” offshore gas production pipeline

• Specific challenges:
  • Ultrasonic inspection to take place against compressed gas pressure.
  • Installation to remain in production, branch taken out of production
  • Bidirectional operation, launching & returning on platform
  • Online data review to prevent “overshoot” (Wye-piece in PLEM)

• Scope of work
  • Modifying tool to meet operational conditions
  • Gauging & inspection up to PLET
  • Length of inspection: 1350 ft / 450 m
18” offshore gas production pipeline

- **Project approach**
  - Procedure development, job planning, equipment preparation
  - Separate windows for gauging & inspection
  - Quick turnaround, minimum impact on on-board activities
  - Gaugerun & inspection in isolated section against compressed gas
  - Pigtransmitter detection for emergencies

- **Preparation:**
  - Test inspection pig for 1160 psi / 80 bar operation
    - Incl. realtime data feed
    - Bidirectional setup
18” offshore gas production pipeline

- Project pre-execution
  - Gaugerun cancelled: isolation proved impossible
  - Review of project plan:
    - Runs to be executed against system pressure
    - Gaugerun & inspection in single execution
    - On-line data critical for location verification

- Execution:
  - Gaugerun based on pumped volume (safe margin)
  - Bidirectional inspection in batch gasoil up to PLEM
  - Total execution time: 4 days
  - Small operational footprint
8” between a subsea manifold and platform

• Specific challenges:
  • Cleaning, gauging & inspection of 8” ‘single entry’ production pipeline
  • Multiple runs cleaning from subsea launcher to platform
  • Heavy wall riser, high resolution inspection of riser section
  • Bidirectional inspection, launching & returning on platform
  • Online data to ensure inspection success prior to dewatering

• Scope of work
  • Project engineering, simops project management
  • Engineering & manufacturing of subsea launching facility
  • Chemical & mechanical cleaning, gauging, inspection & dewatering
  • 24hrs rotation scheme
8” between a subsea manifold and platform

- Project approach
  - Detailed step-by-step project engineering
  - Manufacturing of certified 600#/2500# 8” subsea launching facility
  - Pre-loaded cleaning tools in subsea launcher
  - One by one piglaunch by onboard flow & valve manipulation
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- Detailed project plan:
8” between a subsea manifold and platform

• Project equipment:
  • Water pumps, filters, analyzing equipment, storage tanks
  • Subsea launching facility with hoses, measuring equipment
  • Chemical injection pumps for cleaning and biocide pumping operation
  • Nitrogen tank & pump
  • Nitrogen, cleaning agent and biocide
  • Temporary piglauncher on platform with hoses, measuring equipment
  • Cleaning pigs, dummy pig
  • Inspection equipment
8” between a subsea manifold and platform

- **Project execution:**
  - Installation of subsea pig launching facilities with 5 preloaded pigs
  - Installation of temporary piglauncher on platform
  - Installation of water, chemical & nitrogen pumping spread on dive-support vessel
  - Run of 4 cleaning pigs with cleaning agent, water to storage tanks and analyzed
  - Dummy pig run bidirectional from platform to subsea facility and back,
  - Inspection run bidirectional from platform to subsea facility,
    - High resolution coverage of riser section
    - Verify inspection success using on-line data
  - Return pig in batch containing biocide
  - Launch final preloaded pig with Nitrogen
  - Reinstate pipeline for operation after purge
‘standard’ 4” with heavy wall thickness bends

- Project origin:
  - Project started as ‘regular’ offshore inspection of 3 production pipelines
  - Project included displacement, dummy-run, inspection and dewatering
  - During initial project, dummy pig was received heavily damaged
  - Operation cancelled until more info became available
  - Divers confirmed heavy wall subsea bend
  - Geometry confirmed by caliper
‘standard’ 4” with heavy wall thickness bends

- Specific challenges:
  - 1.5D bends topsides (SCH80-120)
  - Heavy wall bends subsea (ID: 3” / 77.5 mm)
‘standard’ 4” with heavy wall thickness bends

- Redesign of tool
- Test-setup to prove configuration
- Preserve tool characteristics:
  - Online data (fibre optic)
  - Freeswimming data storage
  - Bidirectional capabilities
  - Pigtransmitter integrated
‘standard’ 4” with heavy wall thickness bends

- Final outcome:
  - Remobilization after client witness of successful tests
  - Successful inspection of all three pipelines
12” water injection riser in a dry caisson

- Specific challenges:
  - Visual inspection → inspection on the risers’ status
  - Pumping operation not possible, isolated subsea
  - Inconel cladded bulkhead design
12” water injection riser in a dry caisson

• Scope of work:
  • Project engineering
  • Winch operated set-up, dry testing required
  • Offshore operations, winter conditions
12” water injection riser in a dry caisson

- **Execution:**
  - Lower tools by winch to desired depth (online data verification)
  - Pass area of interest multiple times at lowest possible speed
  - Complete entire riser inspection in controlled return run
8” – 12” Dual Diameter interfield pipeline

- Global challenge:
  - Identical layout in North America & Asia
  - Platform to platform pipelines
  - 12” risers & 8” sealines
  - Risers to be inspected by bidirectional pumping (alt. option by winch)
  - Sealine to be inspected through 12” risers
8” – 12” Dual Diameter interfield pipeline

- **Execution:**
  - 12” pulling pig configuration of 8” *Piglet*
  - 12” Bidirectional single body Piglet
  - *Even with unexpected sharp diameter transfer*
Conclusion

• Offshore pipelines among the most challenging
  • Pipeline configurations (due to restricted space)
  • Wall thickness & diameter changes common
  • Solutions require insight and creativity
  • Project execution requires thorough preparation, adaptation requires experience
  • Piglet compact form factor allows diverse applications in challenging environments

but most pipelines currently considered unpiggable can be inspected

• Intero Integrity Services manages to combine the operational experience and the tool’s diverse application range to get the job done.
Thank you.

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